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ST41200N/ND (SCSI-2)

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Product Manual

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Volume 1

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Corporate Headquarters
920 Disc Drive Scotts Valley, California 95066-4544, USA
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**Seagate
ST41200N/ND
(SCSI-2)**

**Product Manual
Volume 1**

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NOTICE:

Product Manual 77765374 is Volume I of a two Volume document with the SCSI interface information in the Volume II SCSI Interface Product Manual, P/N 77765466.

If the SCSI Interface information is needed the Volume II Interface Manual should be ordered, P/N 77765466.

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1.0 SCOPE

This specification describes the Seagate Technology, Inc. Model ST41200N/ND WREN™ 7 Disc Drive. This high capacity, high performance member of the 5 1/4 inch WREN rigid disc family incorporates the basic WREN 5 type HDA (Head/Disc Assembly) with some improvements to ST41200N/ND and has an embedded SCSI controller. Performance information is given in Section 5. The Model ST41200N/ND interface is defined for functional compatibility to a subset of the Seagate SCSI Interface Specification 77765466, and the ANSI SCSI-2 standard. The Model ST41200N/ND WREN is classified as an "Intelligent" peripheral. The ST41200N/ND provides Level 2 conformance (highest level) with the ANSI SCSI-1 standard. Details of the ST41200N/ND SCSI implementation are provided in Section 11 of this specification, (Vol. 1) and in the SCSI Interface Product Manual P/N 77765466 (Vol. 2).

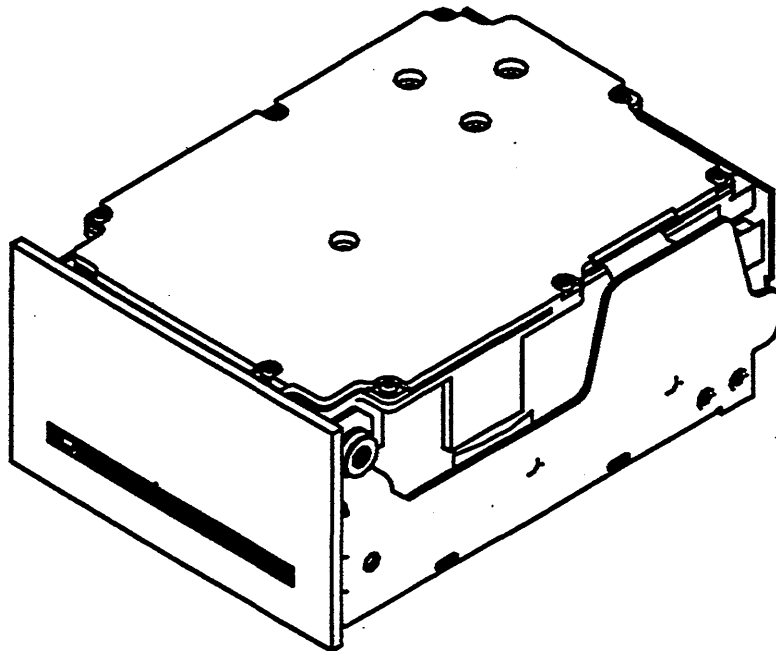


FIGURE 1-1. ST41200N/ND WREN 7

2.0 APPLICABLE STANDARDS AND REFERENCE DOCUMENTATION

2.1 STANDARDS

The ST41200N/ND has been developed as a system peripheral to the highest standards of design and construction. The ST41200N/ND depends upon its host equipment to provide adequate power and environment in order to achieve optimum performance and compliance with applicable industry and governmental regulations. Special attention must be given in the areas of safety, power distribution, shielding, audible noise control, and temperature regulation.

The ST41200N/ND complies with Seagate standards as noted in the appropriate sections of this specification and the Seagate SCSI Interface Specification, P/N 77765466.

The ST41200N/ND is a UL Recognized component per UL 478 or UL 1950, CSA 22.2 No. 220-M1986 or CAN/CSA-C22.2 No. 950-M89, DIN VDE 0805/05.90 and EN60950:1988 (IEC 950)).

The ST41200N/ND, as delivered, is designed for system integration before use. It is supplied as a component or subassembly as defined in the FCC Rules and Regulations, Part 15, Subpart J governing EMI of computing devices and the Radio Interference Regulations of the Canadian Department of Communications. The ST41200N/ND is, therefore, not directly subject to the FCC rules and regulations or the Radio Interference Regulations of the Canadian Department of Communications.

CAUTION

To avoid potential service problems, observe the following precautions:

- Labels must not be put over the breather holes on the top of the drive.
- If a label has been placed over the breather holes, do not poke holes through the label, as the filter underneath is certain to be damaged, allowing contamination to enter. REMOVE THE LABEL. Do not use solvents to remove the adhesive residue. Small amounts of solvent may migrate down the breather holes and contaminate the disc.
- The Manufacturers installed labels must not be removed from the drive or covered with additional labels, as they contain information required when servicing the product.
- DC power should not be switched on to the drive by plugging an electrically "live" DC source cable into the drive power connector. This practice adversely affects the reliability of the connector contacts.

2.2 REFERENCE DOCUMENTATION

2.2.1 Applicable Reference Documents

SCSI Installation Handbook	Seagate P/N 77765375
Product Manual - WREN SCSI Interface	Seagate P/N 77765466
ANSI Small Computer System Interface (SCSI): Document Number ANSI3.131-1986 (X3T9/84.40 Rev. 1B) (X3T9.2/82-2 Rev. 17B) and X3T9.2/86-109 Revision 10C (SCSI-2).	

In case of conflict between this document and any referenced document, this document shall take precedence.

2.2.2 Individual Page Revision Status

Changes to individual pages of this specification are reflected in the revision letter at the top right corner of the page, after the part number. The revision letter applies to that page only and does not change when the specification revision changes unless a change was made on the page, in which case it takes the latest revision letter of the specification. In comparing different revisions of the specification, note that the pages with the same revision letters as the specification were the ones changed to achieve that particular specification revision.

The above practice is for the purpose of avoiding re-typing and re-microfilming every page in the specification every time a few pages are changed.

3.0 GENERAL DESCRIPTION

The ST41200N/ND is a member of a family of low cost, high performance, highly reliable, random access storage devices designed to meet the needs of the OEM marketplace.

The ST41200N/ND is designed to record and recover data on eight 5-1/4 inch (130 mm) fixed discs.

The WREN 7 supports the Small Computer System Interface-2 (SCSI-2) as described in the ANSI SCSI and SCSI-2 Interface Specifications to the extent described in this product specification, which defines the product performance characteristics, and the SCSI Interface Product Manual P/N 77765466 which describes the interface characteristics of the WREN 7.

3.0 (continued)

The WREN 7 SCSI interface supports multiple initiators, disconnect/reconnect, self configuring host software and automatic features that relieve the host from the necessity of knowing the physical characteristics of the targets (logical block addressing is used).

The Head, Disc and Actuator chamber (HDA) is environmentally sealed at the factory. Air is recirculated within the HDA through a nonreplaceable filter to maintain a contamination free disc/actuator environment.

Refer to Figure 3.0-1 for an exploded view of the WREN 7. NEVER disassemble the WREN Head/Disc Assembly (HDA). This exploded view is for information only. Servicing items in the sealed environmental enclosure (heads, media, actuator, etc.) requires special facilities. The drive contains no parts replaceable by the user.

The WREN 7 uses a dedicated landing zone at the innermost radius of the media thus eliminating the possibility of destroying or degrading data by landing in the data zone. The drive automatically goes to the landing zone when the power goes off.

The WREN 7 incorporates an automatic shipping lock which prevents potential damage to the heads and discs caused by movement during shipping and handling. The shipping lock is automatically disengaged when power is applied to the drive.

The WREN 7 decodes Track 0 location from the dedicated servo surface thereby eliminating mechanical transducer adjustments and related reliability concerns.

The WREN 7 uses a high performance actuator assembly consisting of a low inertia, balanced, patented, straight arm design which provides excellent performance with minimum power dissipation.

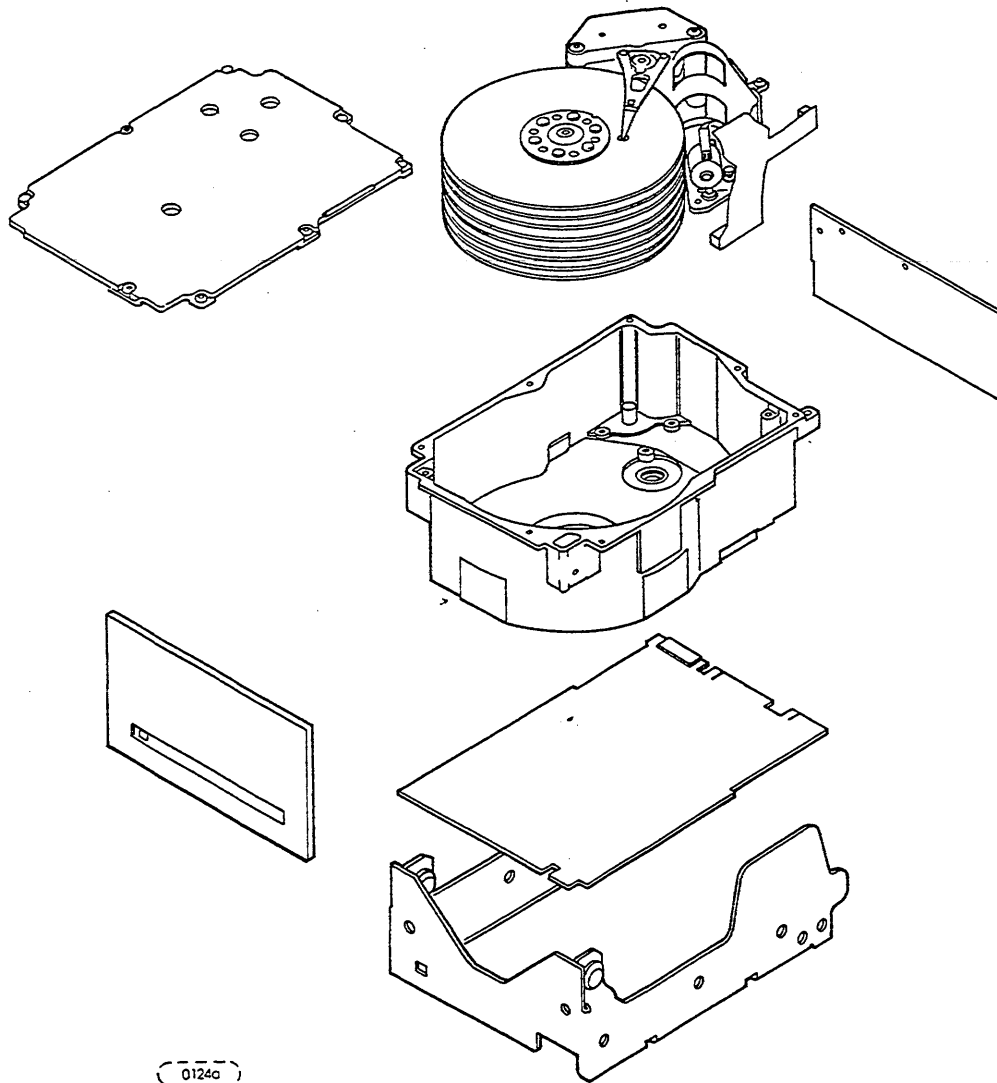


FIGURE 3.0-1. ST41200N/ND WREN 7

4.0 FEATURES

4.1 STANDARD FEATURES

The WREN 7 has the following standard features:

- Integrated SCSI Controller - supports ANSI SCSI-2 operation
- Single Ended or Differential SCSI drivers and receivers
- Asynchronous SCSI bus data transfer protocol
- Synchronous SCSI bus data transfer protocol

4.1 (continued)

- 240 kilobyte RAM buffer
- Prefetch/Multi-segmented cache Buffer Management
- Write Cache Buffer Management
- Selectable data block size
- Flawed sector reallocation at format time
- Reallocation of defects on command (Post Format)
- Selectable automatic reallocation
- User selectable reallocation sector locations:
 - On each track, or
 - Within a cylinder, or
 - Within dedicated tracks
 - Combinations of the above, or
 - None of the above
- Error Correction (48 bit ECC polynomial)
- 1:1 sector interleave
- Data recovery circuitry contained in the WREN 7
- Multiple capacity configurations
- Sealed head, disc and actuator chamber
- No preventive maintenance required
- No adjustments required
- LSI circuitry for high reliability
- Low audible noise for office environment
- Vertical or horizontal mounting
- Low power consumption
- Balanced low mass rotary voice coil actuator
- Automatic shipping lock
- Terminators (accessible without disassembly)
- Integral HDA isolation mounts
- Dedicated head landing zone
- Dynamic spindle brake
- Automatic retries on seek or data read errors (read retries can be disabled)
- Command Queuing of up to 16 commands
- Automatic single track seek error correction capability
- Zone Bit Recording
- Automatic Adaptive Thermal Compensation
- Novell "Netware Ready" Option Available

4.2 UNFORMATTED AND FORMATTED CAPACITIES

Unformatted Capacity:

Unformatted capacity of the WREN 7 ST41200N/ND is 1201.2 MB

Formatted Capacities:

Formatted capacity depends on the number of spare reallocation sectors reserved and the number of bytes per sector. The following table shows some typical formatted capacities.

Spare Sectors or Cylinders <u>Reserved for reallocation</u>	Sector Size*	
	<u>512 Bytes/Sector</u>	<u>1024 Bytes/Sector</u>
No Spares	1055 MB	1116 MB
One Spare Sector Per Track	1040 MB	1086 MB
Two Spare Cylinders per Unit**		
Five Spare Sectors per cyl. One Spare Cyl. per Unit**	1050 MB	1106 MB

*Selectable at format time. The user may modify the data block size before issuing a format command and obtain different formatted capacities than those listed. User available capacity will depend on spare reallocation scheme selected. See Mode Select Command and Format Command in the WREN SCSI Interface Product Manual P/N 77765466.

**Spare cylinders are on the inner tracks.

The standard OEM model is as follows:

	<u>FORMATTED DATA BLOCK SIZE*</u>		<u>UNFORMATTED</u>
	<u>1024 Byte</u>	<u>512 Byte</u>	
ST41200N/ND	1086 MB	1040 MB	1201.2 MByte

*One Spare Sector per Track, Two spare cylinders/unit.

4.3 OPTIONS (factory installed)

The capacities shown in paragraph 4.2 are available upon request. Other capacities can be ordered depending on sparing scheme and sector size requested.

4.3 (continued)

The following options may be specified to be incorporated at the time of production. See Section 12.0.

- Front panel (optional LED lens colors red, amber, green) - See Figure 3.0-1
- Single Unit shipping pack
- Installation Manual (77765375)

4.4 OPTIONAL ACCESSORIES (user installed)

The following accessories are available. All kits may be installed in the field. See Section 13.0.

- Front Panel Kit (optional LED lens colors red, amber, green) - See Figure 3.0-1
- Single Unit shipping pack kit

5.0 PERFORMANCE CHARACTERISTICS

5.1 INTERNAL DRIVE CHARACTERISTICS (Transparent to User)

Drive Capacity	1.2 GByte (unformatted)
Read/Write Heads	15 Data (Max)
Bytes/Track	41301 Bytes (Avg)
Bytes/Surface	80 Mbyte
Tracks/Surface, Total	1931 Tracks (user accessible)
Tracks/Inch	1600 TPI
Servo Heads	1
Recording Mode	1,7
Internal Data Transfer Rate	15-22 Mbits/sec (variable with zone)
	1.875-2.75 Mbytes/sec (variable with zone)
Disc Rotational Speed	3597 +0.5% r/min

5.2 SCSI SEEK, READ AND WRITE PERFORMANCE CHARACTERISTICS (Visible to User) [8]

Refer to the WREN SCSI Interface Product Manual 77765466 for additional timing details.

[] Notes are listed in Section 5.3.1.

5.2.1 Seek Time

		<u>Drive Level</u>		<u>Including Controller Overhead (without disconnect) [1] [4]</u>	
Average -	Typical	15.0 ms	[3]	15.75 ms	[3]
	Max.	16.5 ms	[2]	17.30 ms	[2]
Single Track -	Typical	2.5 ms	[3]	3.20 ms	[3]
	Max.	4.0 ms	[2]	4.75 ms	[2]
Full Stroke -	Typical	34.0 ms	[3]	34.85 ms	[3]
	Max.	37.0 ms	[2]	37.90 ms	[2]

5.2.2 Format Drive Command Execution Time [1]

Maximum (with verify) 35 minutes Maximum (no verify) 17 minutes

**5.2.3 Read Data Command Execution Time [4]
(512 Byte Sector Size, without disconnect and with Read Look Ahead Cache Disabled). Latency time is included.**

- a. From CDB reception to the WREN 7 request for the first data byte to be transferred to the Host
 - 1. Typical (Zero Stroke Seek) 11.1 ms [3]
 - 2. Typical (Average Seek) 25.1 ms [3]
 - 3. Maximum (Full Stroke Seek) 55.7 ms [2]

- b. Single Sector Read and Transfer of data to Host (time from receipt of last byte of the CDB to the request for a status byte transfer to Host) [7].
 - 1. Typical (Zero Stroke Seek) 11.8 ms [3]
 - 2. Typical (Average Seek) 25.8 ms [3]
 - 3. Maximum (Full Stroke Seek) 56.4 ms [2]

[] Notes listed in Section 5.3.1.

**5.2.4 Write Data Command Execution Time [4].
(512 Byte Sector Size, without disconnect and with Read Look Ahead Disabled) Latency time is included.**

- a. From CDB reception to the request for the first byte of write data from the Host.
 - 1. Typical 0.5 ms 2. Maximum 0.6 ms

5.2.4 (continued)

b. Single Sector Write and Data Transfer from Host [7] [6]

(Time from receipt of the last byte of the CDB to the request for a completion status transfer to the Host)

- 1. Typical (Zero Stroke Seek) 11.5 ms [3]
- 2. Typical (Average Seek) 25.5 ms [3]
- 3. Maximum (Full Stroke Seek) 56.1 ms [2]

5.3 GENERALIZED PERFORMANCE CHARACTERISTICS

Minimum Sector Interleave 1 to 1

Data Buffer To/From Disc Media

Data transfer Rate (< 1 sector) - 512 Byte Sector

- Min. [4] 1.87 MByte/sec
- Avg. [4] 2.51 MByte/sec
- Max. [4] 2.75 MByte/sec

Data Buffer To/From Disc Media

Data Transfer Rate (< 1 Track) - 512 Byte Sector

- Min. [4] 1.66 MByte/sec divided by (Interleave Factor)
- Avg. [4] 2.22 MByte/sec divided by (Interleave Factor)
- Max. [4] 2.44 MByte/sec divided by (Interleave Factor)

SCSI Interface Data

Transfer Rate (Asynchronous) [5]

- Maximum Instantaneous 3.0 MBytes/sec
- Average Instantaneous 1.65 MBytes/sec

Sector Sizes 512 user data blocks (default)
Variable (180 to 4096)

Synchronous Transfer Rate

From 1.0 MBytes/sec to 4.8 MBytes/sec in 23.8 kByte/sec to 25 KBytes/sec increments (See section 11.5.)

[] Notes listed in Section 5.3.1

5.3 (continued)

Read/Write consecutive sectors on a track	YES
Flaw reallocation performance impact (For flaws reallocated at format time using the spare sectors per track reallocation scheme.)	Negligible (typically 1 sector time)
Flaw reallocation performance impact (For flaws reallocated at format time using the spare sectors per cylinder reallocation scheme.)	Min-1 sector time (If flaw on same track as spare) Normally - 17 ms Max - 34 ms
Flaw reallocation performance impact (For flaws reallocated at format time using the spare tracks per volume reallocation scheme.)	50 ms (typical)
Overhead time for head switch (512 byte sectors)	Less than 2 ms
Overhead time for one track cylinder switch	<6 ms Typical
Average rotational latency	8.33 ms

5.3.1 Notes for Sections 5.2 and 5.3.

- [1] Execution time measured from receipt of the last Byte of the Command Descriptor Block (CDB) to the request for a Status Byte Transfer to the Initiator (excluding connect/disconnect).
- [2] Maximum times are specified over the worst case conditions of temperature, voltage margins and drive orientation. When comparing specified seek times, care should be taken to distinguish between typical seek times and maximum seek times. The best comparison is obtained by system benchmark tests conducted under identical conditions.
- [3] Typical Seek values are measured under nominal conditions of temperature, voltage, and horizontal orientation as measured on a representative sample of WREN 7 drives.
- [4] Assumes no errors and no sector has been relocated.
- [5] Rate measured from the start of the first sector transfer with the Host.

5.3.1 (continued)

- [6] Assumes the Initiator immediately begins sending Write Data to the WREN 7 when requested.
- [7] Command execution requires a data transfer phase (Data To/From the disc media). Assumes the initiator is instantly ready to send/receive the Data when the WREN 7 generates first request for a data byte transfer, and assumes an average data transfer rate between the WREN 7 and the Initiator of 1.50 Mbytes/second.
- [8] All performance characteristics assume that automatic adaptive temperature compensation is not in process when the SCSI command is received. A SCSI command being executed will not be interrupted for automatic adaptive temperature compensation. If adaptive thermal compensation is in process when a SCSI command is received, the command will be queued until the compensation for the specific head being compensated completes. When compensation completes for the specific head being compensated, the first queued SCSI command will be executed. When execution of the first queued command is complete, the compensation for the remaining head(s) will be continued. The above procedure continues until compensation for all heads is completed, or until one and a half minutes has elapsed. If the compensation for all heads is not complete in one and a half minutes, the drive performs compensation for all of the remaining heads sequentially without any interruption. An automatic adaptive temperature compensation cycle is initiated approximately once every 10.5 minutes and only when a bus free condition between commands is detected. Automatic adaptive temperature compensation takes less than 0.1% of bus time. Automatic temperature compensation also occurs at other times, but should be transparent to the user (e.g., during format, Rezero Command, at spindle up, during read error recovery, and during Reassign Block functions). A Rezero command can be used to reset the thermal compensation cycle back to its start so that the host can know when the interruption for thermal compensation will occur.

5.4 START/STOP TIME

After DC power has been applied, the WREN 7 will become ready within 39 seconds if the Motor Start Option is disabled (i.e. the motor starts as soon as the power has been applied). During this time the drive will respond to some commands over the SCSI interface*. Stop time will be less than 30 seconds from removal of DC power.

If the Motor Start Option is enabled the internal controller will accept the commands listed in the SCSI Interface Product Manual* less than 1 second after DC power has been applied. After the Motor Start Command has been received the WREN 7 will become ready for normal operations within 36 seconds. The Motor Start Command can also be used to command the WREN 7 to stop the spindle*.

There is no power control switch on the drive.

*SCSI Interface Product Manual P/N 77765466.

5.5 PREFETCH/MULTI-SEGMENTED CACHE CONTROL

The WREN 7 provides a Prefetch/Multi-Segmented Cache algorithm that in many cases can enhance system performance. This feature is selected by issuing the Mode Select Command with the proper values in the applicable bytes in pages 08h and 38h*.

In general, 192 Kbytes of the 240 Kbytes physical buffer space in the WREN 7 can be used as a cache. The cache is divided into logical segments from which data is read and to which data is written. WREN 7 keeps track of the logical block addresses of the data stored in each segment of the cache. If the cache is enabled (see RCD bit, Table in the SCSI Interface Product Manual*), data requested by the host with a Read command is retrieved from the cache, if possible, before any disc access is initiated. Data in contiguous logical blocks immediately beyond that which was requested by the Read command can be retrieved and stored in the cache for immediate transfer to the initiator on subsequent Read commands. This is referred to as the prefetch operation. Since data that is prefetched may replace data already in the cache segment, an initiator can limit the amount of prefetch data to optimize system performance. The WREN 7 never prefetches more sectors than the number specified in bytes 8 and 9 of Mode Page 08h. If the cache is not enabled, 240 Kbytes of the buffer is used as a circular buffer for Read/Writes, with no prefetch operation and no segmented cache operation.

The following is a simplified description of the Prefetch/Cache operation:

Case A - Read command is received and the first logical block (LB) is already in cache:

1. Transfer to the initiator the first LB requested plus all subsequent contiguous LB's that are already in the cache. This data may be in multiple segments.
2. When a requested LB is reached that is not in any segment, fetch it and any remaining requested LBA's from the disc and put them in a segment of the cache. Transfer the remaining requested LB's from the cache to the initiator in accordance with the "Buffer-full" ratio specification given in Mode Select Disconnect/Reconnect parameters, page 02h*.
3. Prefetch additional LB's contiguous to those transferred in #2 above and store in the segment. Stop filling segment when the Maximum Prefetch value* has been transferred.

*SCSI Interface Product Manual, P/N 77765466.

5.5 (continued)

Case B - Read command is received and the first LBA requested is not in any segment of the cache.

1. Fetch requested LB's from the disc and transfer into a segment, and then from there to the initiator in accordance with the "Buffer-full" ratio specification given in Mode Select Disconnect/Reconnect parameters, page 02h*.
2. Prefetch additional LB's contiguous to those transferred in Case A, #2 above and store in the segment. Stop filling segment when the Maximum Prefetch value has been transferred.

During a prefetch, the drive crosses a cylinder boundary to fetch data only if the Cylinder Cross Enable bit is set to 1 in bit 7 of byte 2 of the Mode Select parameters page 38h (default is zero for bit 7).

Each cache segment is actually a self-contained circular buffer whose length is an integer number of sectors. The wrap-around capability of the individual segments greatly enhances the cache's overall performance, allowing a wide range of user-selectable configurations which includes a pure prefetch strategy. WREN 7 supports 1, 2, 3, 4, 6, 8 or 12 segment operation. Divide the 196,608 bytes in the buffer by the number of segments to get the segment size. Default is 1 segment* of 196,608 bytes (see also Table 11.2.1-1 of this spec.).

5.6 ZERO LATENCY READ

The Zero Latency Read (ZLR) function gives the WREN 7 the means to reduce the delay in transferring data to the initiator due to rotational latency delays. This feature is selected by issuing the Mode Select command with the proper values in page 20h*. ZLR is only enabled when caching is disabled. ZLR is only invoked when all the requested data is on one track.

*SCSI Interface Product Manual P/N 77765466.

5.6 (continued)

When data is to be read from the medium, if the first header read falls in the requested data blocks range, the WREN 7 reads the sectors into the drive buffer. Before transferring the data to the initiator, the WREN 7 issues a Modify Data Pointer (MDP) message that gives the initiator an argument to add to the value of the present data pointer. The WREN 7 can then pass data to the initiator out of order. The WREN 7 continues to read sectors until it reaches the end of the data block range requested. The WREN 7 then skips over the sectors not requested and starts reading again when it encounters requested sectors that were missed on the initial read. Before transferring the second half of the requested data, the WREN 7 sends another Modify Data Pointer message to the initiator. The initiator adds the message argument to the present data pointer, which puts the data pointer back to the value it had before the first Modify Data Pointer message was sent. This procedure splits the data transfer into two distinct data transfers in a manner that reduces data access latency time.

5.7 CACHING WRITE DATA

Write caching is a write operation by the WREN 7 SCSI-2 that makes use of a drive buffer storage area where the data to be written to the medium is stored while the drive performs the write command.

Write caching is enabled along with read caching. For write caching, the same buffer space and segmentation is used as set up for read functions. When a write command is issued, the cache is first checked to see if any logical blocks that are to be written are already stored in the cache from a previous read or write command. If there are, the respective cache segments are cleared.

If a 10 byte CDB Write command (2Ah)* is issued with the DPO (data page out) bit set to one then no write data is cached but the cache segments are still checked and cleared, if need be, for any logical blocks that are to be written. If the number of write data logical blocks exceeds the size of the segment being written into, the data is "wrapped around" and written into the beginning of the same cache segment, overwriting the data that was written there at the beginning of the operation. However, the drive does not overwrite data that has not yet been written to the medium.

*SCSI Interface Product Manual P/N 77765466.

6.0 RELIABILITY SPECIFICATIONS

The following reliability specifications assume correct host/drive operational interface, including all interface timings, power supply voltages, and environmental requirements.

Seek Errors	Less than 1 in 10 ⁶ seeks
Read Error Rates [1]	
Unrecovered Data	Less than 1 sector in 10 ¹⁴ bits transferred
Miscorrected Data	Less than 1 sector in 10 ²¹ bits transferred
MTBF	150,000 hours
Service Life	5 years
Preventive Maintenance	None required

NOTES: [1]Error rate specified with automatic retries and data correction with ECC enabled and all flaws reallocated.

6.1 ERROR RATES

The error rates stated in this specification assume the following:

- a. WREN 7 is operated per this specification using DC Power as defined in this specification (see Section 7.2).
- b. The WREN 7 has been formatted with the SCSI FORMAT commands.
- c. Errors caused by media defects or host system failures are excluded from error rate computations. Refer to Paragraph 8.0, Media Characteristics.

6.1.1 Read Errors

Before determination or measurement of read error rates:

- a. The data which is to be used for measurement of read error rates must be verified as being written correctly on the media.
- b. All media defect induced errors must be excluded from error rate calculations.

6.1.2 Environmental Interference

When evaluating systems operation under conditions of Electromagnetic Interference (EMI), the performance of the WREN 7 within the system shall be considered acceptable if the WREN 7 does not generate an unrecoverable condition.

6.1.2 (continued)

An unrecoverable error, or condition, is defined as one which:

1. Is not detected and corrected by the WREN 7 itself;
2. Is not capable of being detected from the error or fault status provided through the WREN 7 or SCSI interface; or
3. Is not capable of being recovered by normal WREN 7 or system recovery procedures without operator intervention.

6.1.3 Write Errors

Write errors can occur as a result of: media defects, environmental interference, or equipment malfunction. Therefore, write errors are not predictable as a function of the number of bits passed.

If an unrecoverable write error occurs because of an equipment malfunction in the WREN 7, the error is classified as a failure affecting MTBF. Unrecoverable write errors are those which cannot be corrected within two attempts at writing the record with a read verify after each attempt, (excluding media defects).

6.1.4 Seek Errors

A seek error is defined as a failure of the WREN 7 to position the heads to the addressed track. There shall be no more than one recoverable seek error in 10⁶ physical seek operations. After detecting an initial seek error, the WREN 7 automatically retries a Rezero Unit and reseeks to the addressed track up to 3 times. If a reseek is successful, the Extended Sense will report a seek positioning error (15h) and the sense key will report a recovered error (1h). If all three reseeks fail, a seek positioning error (15h) will be reported with a Medium (3h) or Hardware error (4h) reported in the Sense Key. This is an unrecoverable seek error. Unrecoverable seek errors are classified as failures for MTBF calculations. Ref. section 5.1.1.2 of SCSI Interface Product Manual P/N 77765466.

6.2 RELIABILITY AND SERVICE

6.2.1 Mean Time Between Failure

The production disc drive shall achieve an MTBF of 150,000 hours when operated in a benign atmosphere at an average disc drive ambient temperature of 95°F (35°C) or less as measured per this Product Specification, paragraph 7.4.1. Short term excursions up to the specification limits of the operating environment will not affect MTBF performance.

6.2.1 (continued)

The following expression defines MTBF:

$$\text{MTBF per measurement period} = \frac{\text{Estimated power-on operating hours in the period}}{\text{Number of drive failures in the period}}$$

Estimated power-on operation hours means power-up hours per disc drive times the total number of disc drives in service. Each disc drive shall have accumulated at least nine months of operation. Data shall be calculated on a rolling average base for a minimum period of six months.

Drive failure means any stoppage or substandard performance caused by drive malfunction.

6.2.2 Preventive Maintenance

No routine scheduled preventive maintenance shall be required.

6.2.3 Service Life

The WREN 7 shall have a useful service life of five years. Depot repair or replacement of major parts will be permitted during the lifetime (6.2.4).

6.2.4 Service Philosophy

Special equipment is required to repair the WREN 7 HDA. In order to achieve the above service life, repairs must be performed only at a properly equipped and staffed service and repair facility. Troubleshooting and repair of PWAs in the field is not recommended, because of the extensive diagnostic equipment required for effective servicing. Also, there are no spare parts available for this drive.

6.2.5 Installation

The WREN 7 is designed, manufactured, and tested with a "Plug in and Play" installation philosophy. This philosophy minimizes the requirements for highly trained personnel to integrate the WREN 7 into the OEM's system, whether in a factory or field environment.

6.2.6 Service Tools

No special tools are required for site installation or recommended for site maintenance. Refer to Paragraph 6.2.4. The depot repair philosophy of WREN 7 precludes the necessity for special tools. Field repair of the drive is not practical since there are no user purchasable parts in the drive.

7.0 PHYSICAL/ELECTRICAL SPECIFICATIONS

7.1 AC POWER REQUIREMENTS: None

7.2 DC POWER REQUIREMENTS

The voltage and current requirements for a single WREN 7 are shown in the following table. Values indicated apply at the drive power connector.

TABLE 7.2-1. DC POWER REQUIREMENTS

	<u>Single Ended</u>		<u>Differential</u>	
	+5 V	+12 V	+5 V	+12 V
Regulation [5]	±5%	±5% [2]	±5%	±5% [2]
Maximum Operating Current [1]	1.0 A	2.0 A	1.8 A	2.2 A
Average Idle Current [1] [3]	0.8 A	1.6 A	1.1 A	1.6 A
Maximum Starting Current (Peak)	1.1 A	4.5 A [6]	1.4 A	4.5 A
Delayed Motor Start (Max) [4]	1.0 A	0.9 A	1.3 A	0.9 A

- [1] Measured with average reading DC ammeter. Instantaneous +12 V current peaks will exceed these values.
- [2] A -10% tolerance is permissible during first 15 seconds of power up, but must be followed by ±5% tolerance thereafter during powerup.
- [3] See +12 V current profile level T5 in Figure 7.2.2-1.
- [4] This condition occurs when the Motor Start Option is enabled and the drive has not yet received a Start Motor command.
- [5] See paragraph 7.2.1 "Conducted Noise Immunity".
- [6] Instantaneous peaks less than 5 msec. in duration are allowed.

General Notes from Table 7.2-1:

1. At powerup, the motor current regulator will limit the 12 volt current to a peak value of less than 4.5 amperes, although instantaneous peaks may exceed this value. These peaks will be 5 msec duration or less.
2. Minimum current loading for each supply voltage is not less than 30% of the maximum operating current shown.

7.2 (continued)

General Notes for Table 7.2-1 (continued)

3. The +5 and +12 volt supplies shall employ separate ground returns.
4. Where power is provided to multiple drives from a common supply, careful consideration for individual drive power requirements should be noted. Where multiple units are powered on simultaneously, the peak starting current must be available to each device.

7.2.1 Conducted Noise Immunity

Noise is specified as a periodic and random distribution of frequencies covering a band from DC to 10 MHz. Maximum allowed noise values given below are peak to peak measurements and apply at the drive power connector.

+5 V =	100 mV pp from 0 to 100 KHz and 30 mA pp* from 100 kHz to 10 MHz.
+12 V =	100 mV pp from 0 to 100 kHz and 40 mA pp* from 100 kHz to 10 MHz.

*This is not an error. Current must be measured in this range.

7.2.2 Power Sequencing

Power sequencing is not required for the WREN 7. The WREN 7 protects against inadvertent writing during power up and down. Daisychain operation requires that power be maintained on the terminated WREN 7 to ensure proper termination of the peripheral I/O cables.

7.2.3 12 V - Current Profile

Figure 7.2.2-1 identifies the WREN 7 +12 Volt current profile. The current during the various times is as shown:

- T1 Power is initially applied to the drive.
- T2 Power is applied to the start winding of the motor and the spindle begins to accelerate.
- T3 Power is applied to the run winding of the motor and the spindle continues to accelerate and reaches operating speed.
- T4 The head-arm restraint solenoid pick occurs and the heads move to the data area of the spindle.
- T5 The autovelocity adjust sequence is performed.

NOTE

All times and currents are typical. See Table 7.2-1 for maximum current requirements.

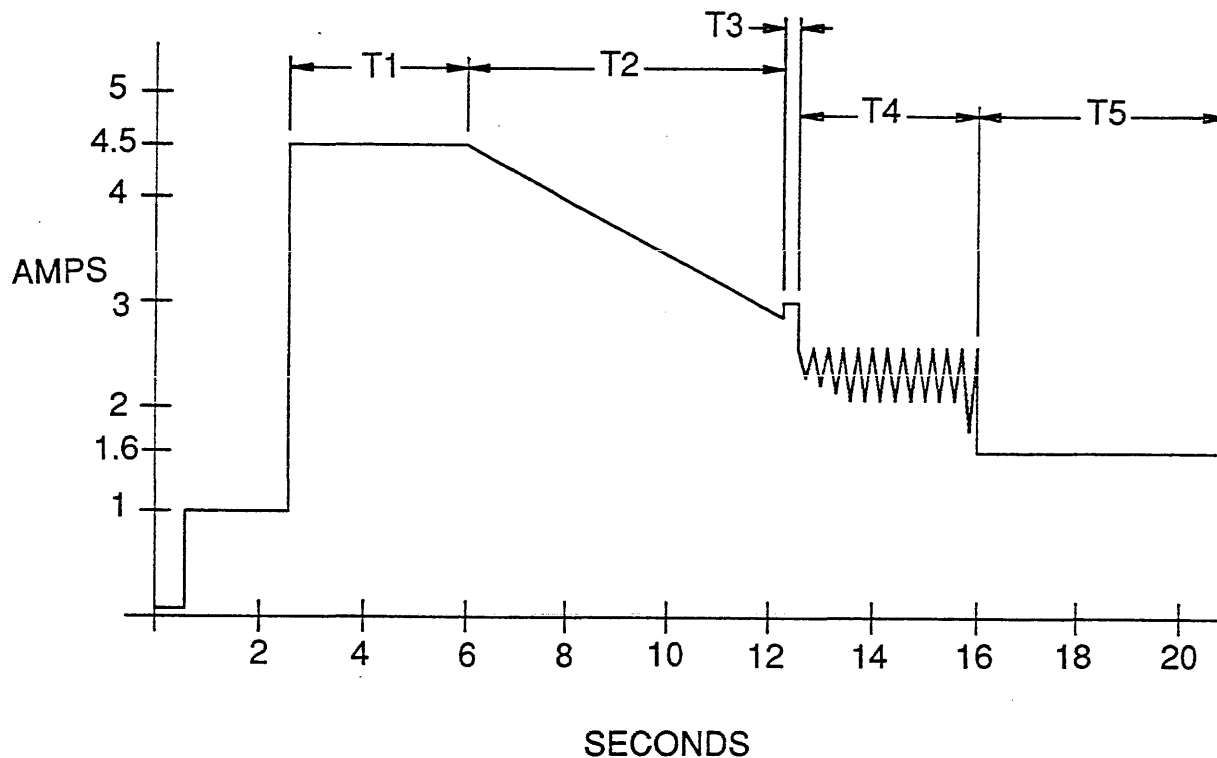


FIGURE 7.2.2-1. TYPICAL WREN 7 +12 V CURRENT PROFILE

7.3 HEAT/POWER DISSIPATION

For drives with single ended interface circuits, typical power dissipation is 31 watts (106 BTUs per hour) of DC power average at nominal voltages. Typical power dissipation under idle conditions is less than 24 watts (82 BTUs) per hour.

For drives having differential interface circuits, typical power dissipation is 32 watts (109.2 BTUs per hour) of DC power average at nominal voltages. Typical power dissipation under idle conditions is 25 watts (85.3 BTUs) per hour.

7.4 ENVIRONMENTAL LIMITS

Temperatures and humidity specifications preclude condensation on any WREN 7 part. Altitude and atmospheric pressure specifications are referenced to a standard day at 58.7°F (14.8°C). Maximum Wet Bulb temperature is 82°F (28°C).

7.4.1 Temperature

a. Operating

The drive will meet all specifications over a 50°F to 122°F (10°C to 50°C) drive ambient temperature range with a maximum gradient of 36°F (20°C) per hour. The enclosure for the drive should be designed such that the temperatures at the locations specified in Table 7.4.1-1, column 1 are not exceeded. Air flow may be needed to achieve these temperature values. Operation at case temperatures above these values may adversely affect the drives ability to meet specifications.

The MTBF specification for the drive is based on operating at an ambient temperature of 95°F (35°C). Occasional excursions to drive ambient temperatures of 50°C or 10°C may occur without impact to specified MTBF. To achieve the specified MTBF, the values of Table 7.4.1-1 Column 2 must be considered maximum average operating case temperatures. Air flow may be needed to achieve these temperatures. Continual or sustained operation at case temperatures above these values may degrade MTBF.

7.4.1 (continued)

TABLE 7.4.1-1. PWA AND HDA TEMPERATURES

Items in Figure <u>7.4.1-1</u>	Column 1 Maximum Case Temperatures <u>Operating</u>	Column 2 Typical Case Temperatures <u>at 35°C Ambient</u>
	<u>Celsius</u>	<u>Celsius</u>
VR1	78	63
U1	75	60
U2	75	60
U10	63	48
U11	81	66
U24	75	60
MDVR	78	63
ADVR	72	57
HDA	59	44

Note: The temperatures in Column 2 were measured with an air flow of 1 ft/sec through the drive at a pressure of one atmosphere.

b. Transit

-40° to 158°F (-40° to 70°C) package ambient with a maximum gradient of 45°F (25°C) per hour. This specification assumes that the WREN 7 is packaged in the shipping container designed by Seagate for use with WREN 7.

c. Storage

14° to 130°F (-10° to 54°C) device ambient with a maximum gradient of 36°F (20°C) per hour.

7.4.1 (continued)

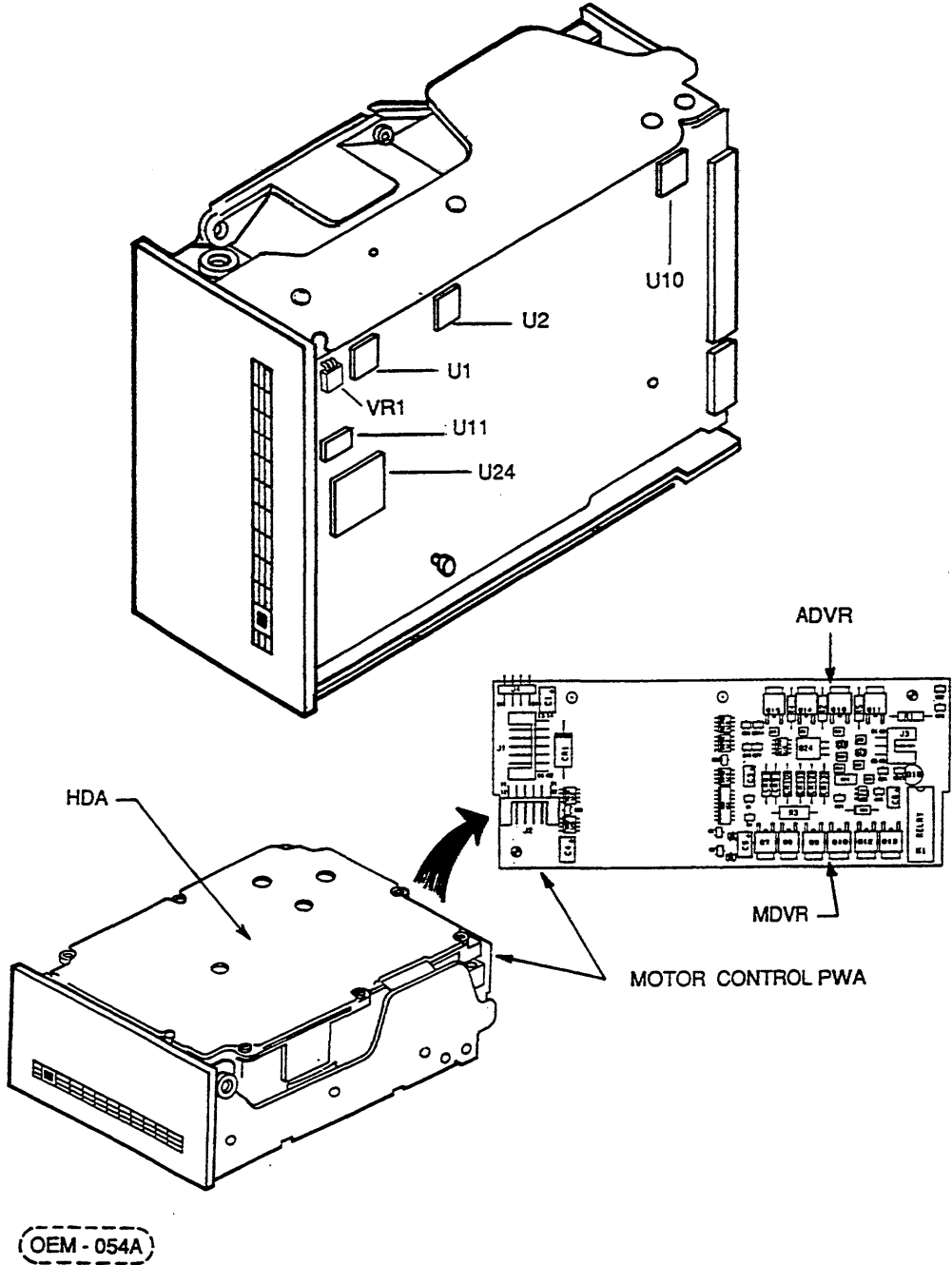


FIGURE 7.4.1-1. LOCATIONS OF COMPONENTS LISTED IN TABLE 7.4.1-1.

7.4.2 Relative Humidity

- a. Operating
8% to 80% relative humidity with a maximum gradient of 10% per hour.
- b. Transit
5% to 95% relative humidity.
- c. Storage
8% to 90% relative humidity.

7.4.3 Effective Altitude (Sea Level Reference)

- a. Operating
-1000 to +10,000 feet (-305 to +3048 metres)
- b. Transit
-1000 to +40,000 feet (-305 to +12,210 metres)
- c. Storage
-1000 to +10,000 feet (-305 to +3048 metres)

7.4.4 Shock and Vibration

Shock and vibration limits specified in this document are measured directly on the WREN 7 chassis. If the WREN 7 is installed in an enclosure to which the stated shock and/or vibration criteria is applied, resonances may occur internally to the enclosure resulting in WREN 7 movement in excess of the stated limits. If this situation is apparent, it may be necessary to modify the enclosure to minimize WREN 7 movement.

The limits of shock and vibration defined within this document are specified with the WREN 7 mounted by any of the four methods shown in Figure 7.4.4-1. Orientation of the side nearest the LED may be up or down, though the figure shows it down.

7.4.4.1 Shock

a. Operating - Normal

The WREN 7, as installed for normal operation, shall comply with the complete specified performance while subjected to intermittent shock not exceeding 2 g at a maximum duration of 10 ms (half sinewave). Shock may be applied in the X, Y, or Z axis.

b. Operating - Abnormal

The WREN 7, as installed for normal operation, shall not incur physical damage while subjected to intermittent shock not exceeding 10 g at a maximum duration of 10 ms (half sinewave). Shock occurring at abnormal levels may promote degraded operational performance during the abnormal shock period. Specified operational performance will continue when normal operating shock levels resume, assuming system recovery routines are available. Shock may be applied in the X, Y, or Z axis.

c. Nonoperating

The limits of nonoperating shock shall apply to all conditions of handling and transportation. This includes both isolated WREN 7 drives and integrated WREN 7 drives.

The WREN 7 subjected to nonrepetitive shock not exceeding 32 g at a maximum duration of 10 ms (half sinewave) shall not exhibit device damage or performance degradation. Shock may be applied in the X, Y, or Z axis.

d. Packaged

The WREN 7 as packaged in a single unit pack by Seagate for general freight shipment shall withstand drop test from 42 inches (1070 mm) against a concrete floor or equivalent.

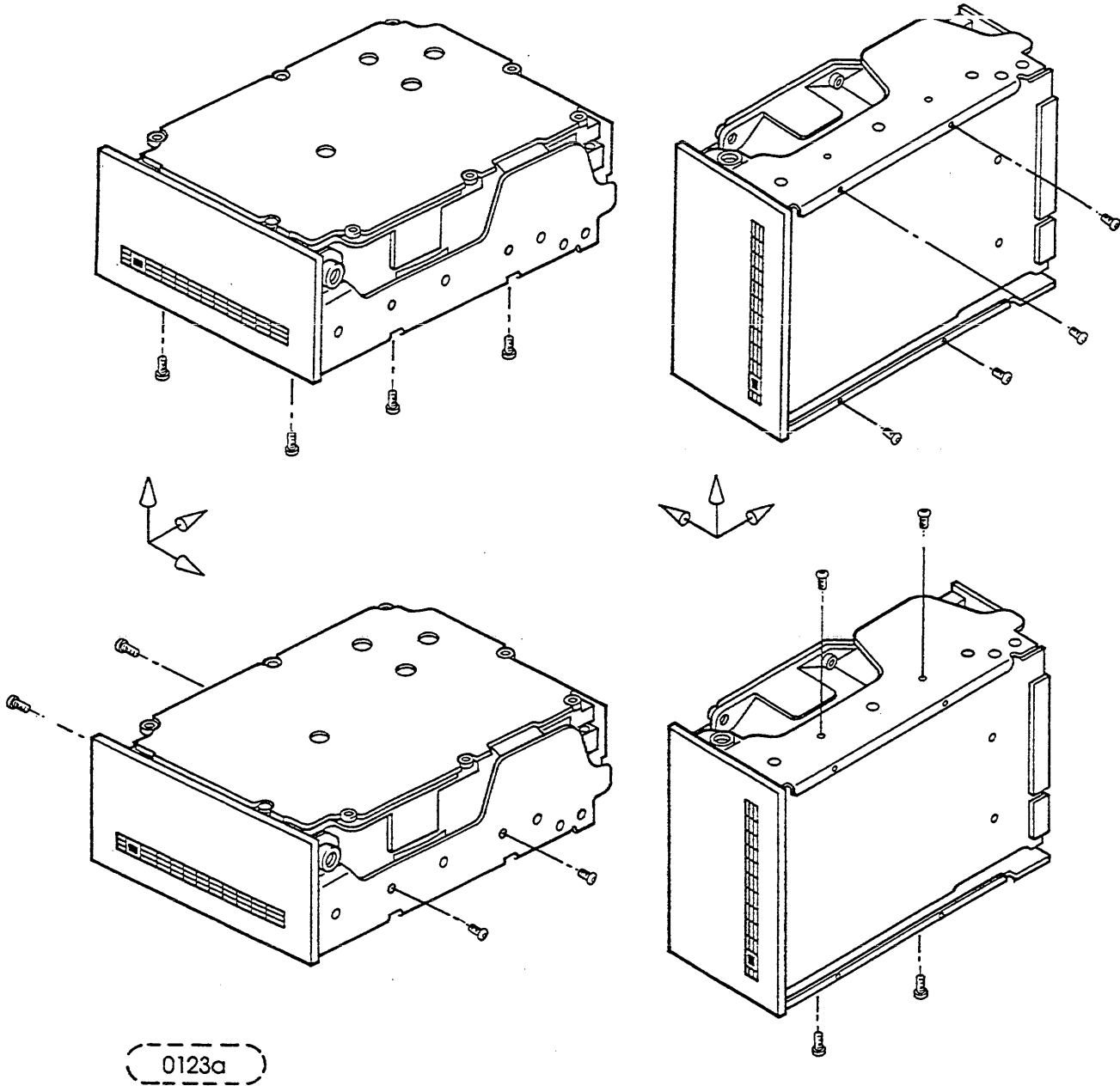


FIGURE 7.4.4-1. RECOMMENDED MOUNTING

7.4.4.2 Vibration

a. Operating - Normal

The WREN 7 as installed for normal operation, shall comply with the complete specified performance while subjected to continuous vibration not exceeding
5-22 Hz @ 0.020 inches (0.51 mm) displacement
22-500 Hz @ 0.5 g

Vibration may be applied in the X, Y, or Z axis.

b. Operating - Abnormal

The WREN 7 as installed for normal operation, shall not incur physical damage while subjected to periodic vibration not exceeding
15 minutes of duration at major resonant frequency
5-22 Hz @ 0.030 inches (.76 mm) displacement
22-500 Hz @ 0.75 g

Vibration occurring at these levels may promote degraded operational performance during the abnormal vibration period. Specified operational performance will continue when normal operating vibration levels are resumed. This assumes system recovery routines are available. Abnormal vibration may be applied in the X, Y, or Z axis.

c. Nonoperating

The limits of nonoperating vibration shall apply to all conditions of handling and transportation. This includes both isolated WREN 7 drives and integrated WREN 7 drives.

The WREN 7 shall not incur physical damage or degraded performance as a result of continuous vibration not exceeding
5-22 Hz @ 0.040 inches (1.02 mm) displacement
22-500 Hz @ 1.00 g

Vibration may be applied in the X, Y, or Z axis.

7.4.5 Air Cleanliness

The WREN 7 is designed to operate in a typical office environment with minimal environmental control.

7.5 ELECTROMAGNETIC COMPATIBILITY

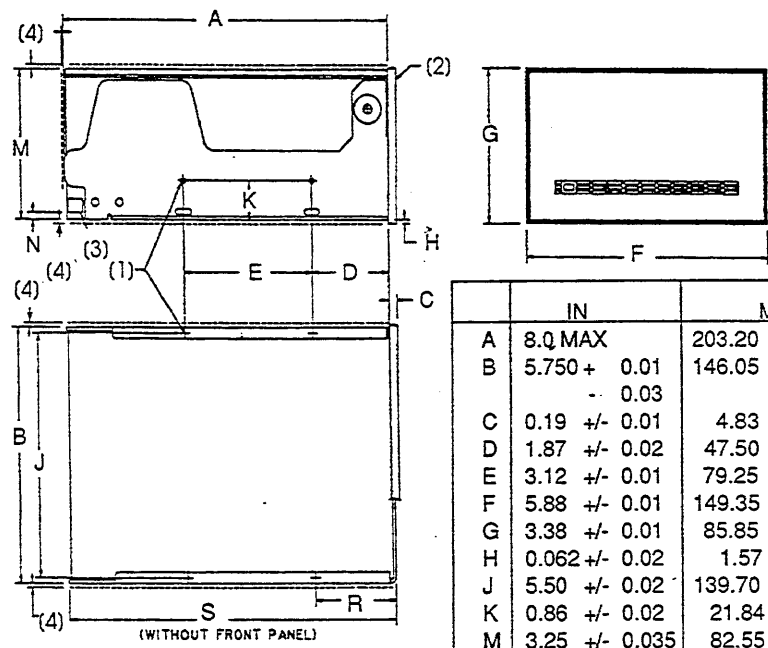
7.5.1 Electromagnetic Susceptibility

As a component assembly, the WREN 7 is not required to meet any susceptibility performance requirements. It is the responsibility of the system integrator to perform those tests required to assure that equipment operating in the same system as the WREN 7 does not adversely affect the performance of the WREN 7. See section 6.1.2, and see Table 7.2-1, DC Power Requirements.

7.6 MECHANICAL SPECIFICATIONS

The following nominal dimensions are exclusive of the decorative front panel accessory. Refer to Figure 7.6-1 for detailed mounting configuration dimensions.

Height: 3.25 in 82.55 mm
 Width: 5.75 in 146.05 mm
 Depth: 8.0 in 203.2 mm
 Weight: 7.6 pounds 3.4 kilograms



INCLUDING SWAY SPACE (4)

	IN	MM
A	8.0 MAX	203.20
B	5.750 + 0.01 - 0.03	146.05 + 0.25 - 0.76
C	0.19 +/- 0.01	4.83 +/- 0.25
D	1.87 +/- 0.02	47.50 +/- 0.51
E	3.12 +/- 0.01	79.25 +/- 0.25
F	5.88 +/- 0.01	149.35 +/- 0.25
G	3.38 +/- 0.01	85.85 +/- 0.25
H	0.062 +/- 0.02	1.57 +/- 0.51
J	5.50 +/- 0.02	139.70 +/- 0.51
K	0.86 +/- 0.02	21.84 +/- 0.51
M	3.25 +/- 0.035	82.55 +/- 0.89
N	0.33 +/- 0.01	8.38 REF
R	1.93 +/- 0.01	49.02 +/- 0.25
S	8.06 MAX	204.7

	IN.	MM.
A.	8.08 MIN.	205.23 MIN.
B	SIDE MOUNTED BOTTOM MOUNTED	5.90 MIN. 149.86 MIN.
M	3.33 MIN.	84.58 MIN.
S	8.14 MIN.	206.76 MIN.

01085

- () NOTES:
1. MOUNTING HOLES FOUR ON BOTTOM. TWO ON EACH SIDE. 6-32-UNC. MAX. SCREW LENGTH INTO SIDE OF CHASSIS 3.17 MM (0.125 IN). MAX. SCREW LENGTH INTO BOTTOM OF CHASSIS IS 3.17 MM (0.125 IN.)
 2. FRONT PANEL ACCESSORY
 3. POWER AND INTERFACE CONNECTIONS
 4. DIMENSIONS A, B, M AND S DO NOT INCLUDE SWAY SPACE. THOSE GIVEN IN SMALL TABLE AT LOWER LEFT INCLUDE SWAY SPACE.

FIGURE 7.6-1. MOUNTING CONFIGURATION DIMENSIONS

7.6.1 Drive Orientation

The balanced rotary arm actuator design of the WREN 7 allows it to be mounted in any orientation. All drive performance characterization, however, has been done with the drive in horizontal (discs level) and vertical (drive on its side) orientations, and these are the two preferred mounting orientations.

7.6.2 Cooling

Cabinet cooling must be designed by the customer so that the ambient temperature immediately surrounding the WREN 7 will not exceed temperature conditions specified in 7.4.1. Specific consideration should be given to make sure adequate air circulation is present around the PWAs to meet the requirements of 7.4.1.

8.0 MEDIA CHARACTERISTICS

8.1 MEDIA DESCRIPTION

The media used on the WREN 7 has a diameter of approximately 5 1/4 inches (130 mm). The aluminum substrate is coated with a thin film magnetic material, overcoated with a proprietary protective layer for improved durability and environmental protection.

9.0 DEFECT AND ERROR MANAGEMENT

WREN 7, as delivered, complies with this specification. The read error rate and specified storage capacity are not dependent upon use of defect management routines by the host (initiator).

Defect and error management in the SCSI system involves WREN 7 internal defect/error management and SCSI systems error considerations (errors in communications between Initiator and WREN 7). Tools for use in designing a defect/error management plan are briefly outlined in this section, with references to other sections where further details are given.

9.1 WREN 7 INTERNAL DEFECTS/ERRORS

Identified defects are recorded on the WREN 7 defects list tracks (referred to as the primary or ETF defect list). These known defects are reallocated during the initial WREN 7 format operation at the factory. (See Format Unit command Section 5.2.1.2 in SCSI Interface Product Manual P/N 77765466*). The WREN 7 internal retries and data correction by ECC should be enabled to recover data from additional flaws if they occur. If data correction by ECC is required to recover data, the host should immediately reallocate this sector by use of the Reassign Blocks command*. If the WREN 7 automatic retries and data correction by ECC are disabled, defects are usually unrecoverable and need to be reallocated as they are discovered. For reallocation of bad sectors, the number of spare sectors per track or cylinder and the number of spare tracks per volume is programmable. After formatting, defects can be automatically reallocated by the WREN 7, or can be reallocated when the host sends the Reassign Blocks Command.

Details of the SCSI commands supported by WREN 7 are described in Interface Manual, P/N 77765466. Also, more information on the WREN 7 Error Recovery philosophy is presented in Section 6 of the SCSI Interface Product Manual.

9.2 SCSI SYSTEMS ERROR CONSIDERATIONS

Information on the reporting of operational errors or faults across the interface is given in SCSI Interface Product Manual. Message Protocol System is described in the SCSI Interface Manual. Several of the messages are used in the SCSI systems error management system. The Request Sense command returns information to the host about numerous kinds of errors or faults. The Receive Diagnostic Results reports the results of diagnostic operations performed by the WREN 7.

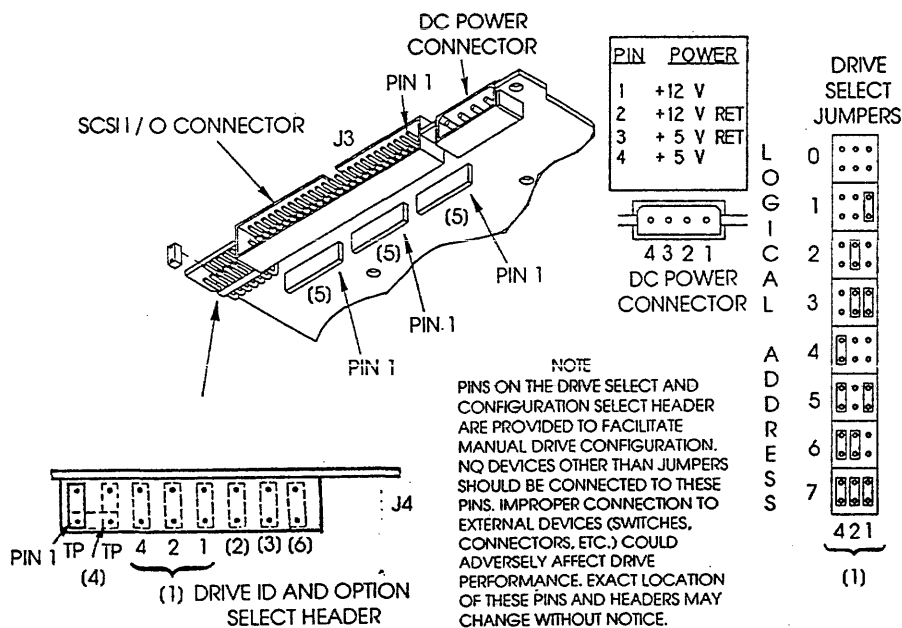
Status returned by the WREN 7 to the Initiator is described in the SCSI Interface Manual*. Status reporting plays a role in the SCSI systems error management and its use in that respect is described in sections where the various commands are discussed.

*SCSI Interface Product Manual P/N 77765466.

10.0 OPTION/CONFIGURATION HEADERS

10.1 DRIVE ID/OPTION SELECT HEADER

Figure 10.1-1 shows the drive ID select and configuration option select jumper header at the rear of the drive next to the SCSI I/O connector. The notes following the figure describe the functions of the various jumper positions on the header.



0125a

FIGURE 10.1-1. WREN 7 SCSI DRIVE ID AND OPTION SELECT HEADER

- [1] Drive ID is binary coded jumper position (most significant bit on left) , ie., jumper in position 1 would be Drive ID 1, no jumpers means ID 0.
- [2] Jumper plug installed enables the Motor Start Option. In this mode of operation the drive will wait for a Start Unit Command* from the Host before starting the Motor. If the jumper plug is not installed see Note [6] below for description of delayed motor start feature.
- [3] Jumper plug installed means parity checking by the WREN 7 is enabled.
- [4] If the unit is not to be terminated, remove terminator resistor module SIPs, see Note [5]. TP Jumper in left vertical position means terminator power (+5 V) is from WREN 7 power connector. Jumper in horizontal position means terminator power is taken from interface cable*. Jumper in right TP position means +5 V is supplied to the interface cable pin 26*. Jumpers can be in both vertical positions at same time. If the drive is not terminated, the TP jumper need not be installed.

*SCSI Interface Product Manual P/N 77765466.

10.1 (continued)

- [5] Removable terminator resistor module SIPs.
- [6] Jumper on enables delayed motor start (Motor Start jumper [2] must be off). Motor start up is delayed 16 times drive ID number in seconds; i.e., Drive 0 starts immediately, Drive 1 starts 16 seconds later, Drive 2 starts 16 seconds after Drive 1, etc.

10.2 WRITE PROTECT/REMOTE LED HEADER

The Write Protect/Remote LED header is a 6-pin, 3 jumper (or connector) position header behind the front panel at the right side of the drive, opposite the LED. See Figure 10.2-1. The pins are on 0.100 inch (2.54 mm) centers both vertically and side to side. A suggested mating two pin connector is the DuPont Mini Latch housing P/N 65291-008 or equivalent. The drive front panel must not be present in order to access the header. For a remote LED capability, plug the remote LED cable connector vertically to the leftmost two pins of the header (as viewed from the front of the drive). The center two pins provide a drive write protect capability. A shorting jumper plug may be plugged vertically onto these two pins to write protect the drive or a two-pin cable connector may be plugged there to connect the two pins to a remote Write Protect switch. The rightmost two pins are reserved for factory use only.

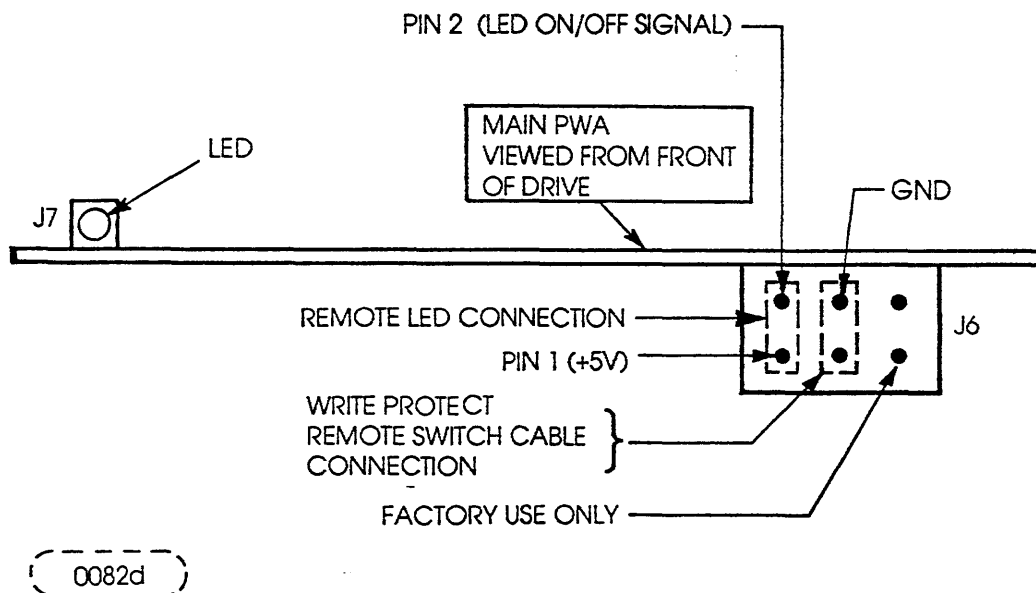


FIGURE 10.2-1. WRITE PROTECT/REMOTE LED HEADER.

11.0 INTERFACE REQUIREMENTS

11.1 GENERAL DESCRIPTION

This section partially describes the interface requirements as implemented on the WREN 7 Model ST41200N/ND drive. The major portion of the interface requirements/implementation is described in the Seagate WREN SCSI Interface Product Manual, P/N 77765466. This section has tables that give the WREN 7 version of the SCSI implementation described in the 77765466 document.

11.2 WREN 7 SCSI INTERFACE MESSAGES SUPPORTED

Table 11.2-1 following lists the messages supported by the SCSI-1 and SCSI-2 modes of the WREN 7.

TABLE 11.2-1. SCSI MESSAGES SUPPORTED BY WREN 7

MSG CODE	SUPPORTED BY:		<u>MESSAGE NAME</u>
	<u>SCSI-1</u>	<u>SCSI-2</u>	
01h***	Y	Y	EXTENDED MESSAGES
06h	Y	Y	ABORT
0Dh	Y	Y	ABORT TAG
0Ch	Y	Y	BUS DEVICE RESET
0Eh	N	Y	CLEAR QUEUE
00h	Y	Y	COMMAND COMPLETE
04h	Y	Y	DISCONNECT
80h-FFh	Y	Y	IDENTIFY
23h	N	N	IGNORE WIDE RESIDUE (two bytes)
0Fh	N	N	INITIATE RECOVERY
05h	Y	Y	INITIATOR DETECTED ERROR
0Ah	Y	Y	LINKED COMMAND COMPLETE
0Bh	Y	Y	LINKED COMMAND COMPLETE WITH FLAG
09h	Y	Y	MESSAGE PARITY ERROR
07h	Y	Y	MESSAGE REJECT
***	N	Y	MODIFY DATA POINTER
08h	Y	Y	NO OPERATION
			QUEUE TAG MESSAGES (two bytes)
21h	N	Y	HEAD OF QUEUE TAG
22h	N	Y	ORDERED QUEUE TAG
20h	N	Y	SIMPLE QUEUE TAG
10h	N	N	RELEASE RECOVERY
03h	Y	Y	RESTORE POINTERS
02h	Y	Y	SAVE DATA POINTER
***	Y	Y	SYNCHRONOUS DATA TRANSFER REQ.
11h	N	N	TERMINATE I/O PROCESS
***	N	N	WIDE DATA TRANSFER REQUEST

***Extended messages (see P/N 77765466 Interface Product Manual).

11.3 WREN 7 SCSI INTERFACE COMMANDS SUPPORTED

Table 11.3-1 following lists the SCSI interface commands that are supported in the SCSI-1 and SCSI-2 modes of the WREN 7. WREN 7 can be changed back and forth between SCSI-1 and SCSI-2 modes using the Change Definition Command.

TABLE 11.3-1. SCSI COMMANDS SUPPORTED BY WREN 7

COM'D CODE	SUPPORTED BY:		COMMAND NAME
	SCSI-1	SCSI-2	
00h	Y	Y	TEST UNIT READY
01h	Y	Y	REZERO UNIT
03h	Y	Y	REQUEST SENSE
	Y	Y	EXTENDED SENSE
	Y	Y	FIELD POINTER BYTES
	N	N	ACTUAL RETRY COUNT BYTES
04h	Y	Y	FORMAT UNIT
07h	Y	Y	REASSIGN BLOCKS
08h	Y	Y	READ
0Ah	Y	Y	WRITE
0Bh	Y	Y	SEEK
12h	Y	Y	INQUIRY
	N	Y	VITAL PRODUCT DATA PAGE
	N	Y	UNIT SERIAL NUMBER PAGE
	N	Y	IMPLEMENTED OPERATING DEF. PAGE
	N	Y	FIRMWARE NUMBERS PAGE
	N	Y	DATE CODE PAGE
	N	Y	JUMPER SETTINGS PAGE
	Y	Y	MODE SELECT (SAME PAGES AS MODE SENSE COMMAND-SEE BELOW)
16h	Y	Y	RESERVE
	Y	Y	3RD PARTY RESERVE
	N	N	EXTENT RESERVATION
17h	Y	Y	RELEASE
18h	N	N	COPY
1Ah	Y	Y	MODE SENSE
	Y	Y	UNIT ATTENTION PAGE (00h)
	Y	Y	BYTE 2 BIT 4 (UNIT ATTN BIT)
	N	N	BYTE 2 BIT 5 (DEID BIT)
	Y	Y	ERROR RECOVERY PAGE (01h)
	Y	Y	DISCONNECT/RECONNECT
			CONTROL PAGE (02h)
	Y	Y	FORMAT PAGE (03h)
	Y	Y	RIGID DISC DRIVE GEOMETRY PAGE (04h)
	Y	Y	VERIFY ERROR RECOVERY PAGE (07h)
	N	Y	CACHING PARAMETERS PAGE (08h)
	N	Y	CONTROL MODE PAGE (0Ah)
	Y	Y	HOST CONTROL OF MDFY DATA POINTERS PG (20h)
	Y	Y	CACHE CONTROL PARAMETERS PAGE (38h)

11.3 (continued)

TABLE 11.3-1. SCSI COMMANDS SUPPORTED BY WREN 7 (continued)

COM'D SUPPORTED BY:			<u>COMMAND NAME</u>
<u>CODE</u>	<u>SCSI-1</u>	<u>SCSI-2</u>	
1Bh	Y	Y	START UNIT/STOP UNIT (STOP SPINDLE)
1Ch	Y	Y	RECEIVE DIAGNOSTIC RESULTS
	Y	Y	SUPPORTED DIAGNOSTICS PAGES
	Y	Y	TRANSLATE PAGE
1Dh	Y	Y	SEND DIAGNOSTICS PAGE
	Y	Y	SUPPORTED DIAGNOSTICS PAGES
	Y	Y	TRANSLATE PAGE
25h	Y	Y	READ CAPACITY
28h	Y	Y	READ EXTENDED
2Ah	Y	Y	WRITE EXTENDED
2Bh	Y	Y	SEEK EXTENDED
2Eh	Y	Y	WRITE AND VERIFY
2Fh	Y	Y	VERIFY
30h	Y	Y	SEARCH DATA HIGH
31h	Y	Y	SEARCH DATA EQUAL
32h	Y	Y	SEARCH DATA LOW
33h	N	N	SET LIMITS
34h	N	N	PRE-FETCH
35h	N	N	SYNCHRONIZE CACHE
36h	N	N	LOCK-UNLOCK CACHE
37h	Y	Y	READ DEFECT DATA
39h	N	N	COMPARE
3Ah	N	N	COPY AND VERIFY
3Bh	Y	Y	WRITE BUFFER [1]
3Ch	Y	Y	READ BUFFER [1]
3Eh	Y	Y	READ LONG
3Fh	Y	Y	WRITE LONG
40h	Y	Y	CHANGE DEFINITION
41-4Bh	N	N	NOT USED
4Ch	Y	Y	LOG SELECT
4Dh	Y	Y	LOG SENSE
4E-5Fh	N	N	NOT USED
60-BFh	N	N	NOT USED
C0-DFh	N	N	NOT USED
EO-FFh	N	N	NOT USED

[1] If cache is enabled (RCD = 0 in Mode Sense Page 08h), Byte Transfer Length is 196,608 bytes plus a 4 byte header.

If cache is disabled (RCD = 1), Byte Transfer length is 245,756 bytes plus a 4 byte header.

11.3.1 Inquiry Data

Table 11.3.1-1 following lists the Inquiry command data that the WREN 7 should return to the initiator per the format given in the SCSI Interface Product Manual P/N 77765466).

TABLE 11.3.1-1. WREN 7 INQUIRY DATA

BYTES	DATA (HEX)
0-15	00 00 [1] [2] 8F 00 00 1A 53 45 41 47 41 54 45 20
16-31	53 54 34 31 32 30 30 20 20 20 20 20 20 20 20 20
32-47	R# R# R# R# S# S# S# S# S# S# S# S# 00 00 00 00
48-63	00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00
64-79	00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00
80-95	00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00
96-111	00 43 6F 70 79 72 69 67 68 74 20 28 63 29 20 31
112-127	39 39 31[3]20 53 65 61 67 61 74 65 20 41 6C 6C 20
128-143	72 69 67 68 74 73 20 72 65 73 65 72 76 65 64 20
144-149	D# D# D# D#

NOTES:

- [1] 01 means SCSI-1 implemented;
02 means SCSI-2 implemented. WREN 7 can be changed between these two configurations.
 - [2] 01 means response data is in SCSI-1 format and has compatability with Common Command Set data.
02 means response data is in SCSI-2 format. WREN 7 can be changed between these two configurations.
 - [3] ASCII code for last digit in the year. This value will change as year number changes.
- R# Four ASCII digits representing the last four digits of the product Firmware Release number.
- S# Eight ASCII digits representing the eight digits of the product serial number.
- D# Four ASCII digits representing the firmware distribution diskette serial number.

11.3.2 Mode Sense Data

Table 11.3.2-1a and 11.3.2-1b following list the values of the data bytes returned by the WREN 7 in response to the Mode Sense command pages for SCSI-1 and SCSI-2 implementation (see SCSI Interface Product Manual, P/N 77765466).

TABLE 11.3.2-1a. MODE SENSE DATA, WREN 7 DEFAULT VALUES
(SCSI-1 IMPLEMENTATION)

BYTES	00	01	02	03	04	05	06	07	08	09	10	11	12	13	14	15	16	17	18	19	20	21	22	23
	5F	00	00	08																				
	00	00	00	00	00	00	02	00																
MODE	<-----MODE PAGE HEADERS AND PARAMETER DATA BYTES----->																							
PAGE																								
DEF*																								
	01	81	06	00	1B	0B	00	00	FF															
CHG*																								
	01	00	00	FF	FF	00	00	00	00															
DEF*																								
	02	82	0A	00	00	00	0A	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00
CHG*																								
	02	00	00	FF	FF	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00
DEF*																								
	03	83	16	00	01	00	01	00	00	00	1E	00	47	02	00	00	01	00	06	00	17	40	00	00
CHG*																								
	03	00	00	FF	FF	FF	FF	00	00	FF	FF	00	00	00	00	00	00	00	00	00	00	00	00	00
DEF*																								
	04	84	12	00	07	8B	0F	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00
CHG*																								
	04	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00
DEF*																								
	38	B8	0E	11	FF	FF	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00
CHG*																								
	38	00	00	5F	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00
DEF*																								
	00	80	02	00	00																			
CHG*																								
	00	00	00	30	FF																			

*DEF = Default value. Standard drives are shipped configured this way.
*CHG = Changeable bits; indicates if default value is changeable.

11.3.2 (continued)

TABLE 11.3.2-1b. MODE SENSE DATA, WREN 7 DEFAULT VALUES
(SCSI-2 IMPLEMENTATION)

BYTES	00	01	02	03	04	05	06	07	08	09	10	11	12	13	14	15	16	17	18	19	20	21	22	23
	90	00	00	08																				
	00	00	00	00	00	00	02	00																
MODE	-----MODE PAGE HEADERS AND PARAMETER DATA BYTES----->																							
PAGE DEF*																								
01	81	0A	00	1B	0B	00	00	00	03	00	FF	FF												
CHG*																								
01	00	00	FF	FF	00	00	00	00	00	00	00	00												
DEF*																								
02	82	0E	00	00	00	0A	00	00	00	00	00	00	00	00	00	00								
CHG*																								
02	00	00	FF	FF	00	00	00	00	00	00	00	00	00	00	00	00								
DEF*																								
03	83	16	00	01	00	01	00	00	00	1E	00	47	02	00	00	01	00	06	00	17	40	00	00	00
CHG*																								
03	00	00	FF	FF	FF	FF	00	00	FF	FF	00	00	00	00	00	00	00	00	00	00	00	00	00	00
DEF*																								
04	84	16	00	07	8B	0F	00	00	00	00	00	00	00	00	00	00	00	00	00	00	0E	0D	00	00
CHG*																								
04	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00	FF	00	00	00	00	00	00
DEF*																								
07	87	0A	00	1B	0B	00	00	00	00	00	FF	FF												
CHG*																								
07	00	00	0F	FF	00	00	00	00	00	00	00	00												
DEF*																								
08	88	0A	00	00	FF	FF	00	00	00	FF	01	80												
CHG*																								
08	00	00	05	00	00	00	00	00	00	FF	FF	00	00											
DEF*																								
0A	8A	06	00	10	00	00	00	00																
CHG*																								
0A	00	00	00	11	00	00	00	00																
DEF*																								
20	A0	03	00	00	00																			
CHG*																								
20	00	00	00	00	01																			
DEF*																								
38	B8	0E	51	00	00	00	00	00	00	00	00	00	00	00	00	00								
CHG*																								
38	00	00	AF	00	00	00	00	00	00	00	00	00	00	00	00	00								
DEF*																								
00	80	02	00	00																				
CHG*																								
00	00	00	30	FF																				

*DEF = Default value. Standard drives are shipped configured this way.

*CHG = Changeable bits; indicates if default value is changeable.

11.4 SCSI BUS CONDITIONS AND MISCELLANEOUS FEATURES SUPPORTED

Asynchronous SCSI bus conditions supported by the WREN are listed in table 11.4-1. These conditions cause the SCSI device to perform certain actions and can alter the phase sequence. Other miscellaneous operating features supported are also listed here.

TABLE 11.4-1. SCSI BUS CONDITIONS AND OTHER MISC. FEATURES

Condition/Feature Supported by:

<u>SCSI-1</u>	<u>SCSI-2</u>	<u>Conditions or Feature</u>
Y	Y	Attention Condition
Y	Y	Reset Condition
N	N	Contingent Allegiance Condition
N	N	Asynchronous Event Notification
Y	Y	Arbitrating System
Y	Y	Disconnect/Reconnect
Y	Y	Asynchronous Data Transfer
Y	Y	Synchronous Data Transfer
N	N	Synchronous (locked) Spindle Operation
N	N	Differential Interface Circuits available
Y	Y	Segmented Caching
N	Y	Zero Latency Read
N	Y	Queue tagging (up to 16 Que tags supported)
N	N	Deferred Error Handling
N	N	Data Rounding
N	N	Reporting actual retry count in Extended Sense bytes 15, 16 and 17.
N	N	Adaptive Caching
N	N	SMP = 1 in Mode Select command needed to save RPL and Rotational Offset bytes (in Table 5.2.1-25 of Vol. II).

<u>SCSI-1</u>	<u>SCSI-2</u>	<u>Status Supported</u>
Y	Y	Good
Y	Y	Check Condition
Y	Y	Condition Met/Good
Y	Y	Busy
Y	Y	Intermediate/Good
Y	Y	Intermediate/Condition Met/Good
Y	Y	Reservation Conflict
Y	Y	Queue Full

11.5 SYNCHRONOUS DATA TRANSFER PERIODS SUPPORTED

Table 11.5-1 list Synchronous Data transfer periods supported by the WREN 7. The data transfer period to be used by the WREN and the initiator is established by an exchange of messages during the Message Phase of operation. See the section on message protocol in the SCSI Interface manual.

TABLE 11.5-1. SYNCHRONOUS DATA TRANSFER PERIODS

<u>M (DECIMAL)</u>	<u>TRANSFER PERIOD (M times 4 nanoseconds)</u>
52	208 ns
62	248 ns
72	288 ns
83	332 ns
93	372 ns
104	416 ns
114	456 ns
125	500 ns
135	540 ns
145	580 ns
156	624 ns
166	664 ns
177	708 ns
187	748 ns
197	788 ns
208	832 ns
218	872 ns
229	916 ns
239	956 ns
250	1000 ns
255	1020 ns

The drive will accept a request for an intermediate value, but will actually transfer data at the next slower rate in the table.

11.6 PHYSICAL INTERFACE

Figure 11.6-1 shows the locations of the physical interface components for the WREN 7 drive. Shown are the locations of the D.C. power connector, the SCSI interface connector, the I/O line terminators, and the drive select and option select header.

Details of the physical, electrical, logical and operational aspects of WREN interfaces are given in the Seagate SCSI Interface Product Manual, P/N 77765466.

NOTE

PINS ON THE DRIVE SELECT AND CONFIGURATION SELECT HEADER ARE PROVIDED TO FACILITATE MANUAL DRIVE CONFIGURATION. NO DEVICES OTHER THAN JUMPERS SHOULD BE CONNECTED TO THESE PINS. IMPROPER CONNECTION TO EXTERNAL DEVICES (SWITCHES, CONNECTORS, ETC.) COULD ADVERSELY AFFECT DRIVE PERFORMANCE. EXACT LOCATION OF THESE PINS AND HEADERS MAY CHANGE WITHOUT NOTICE.

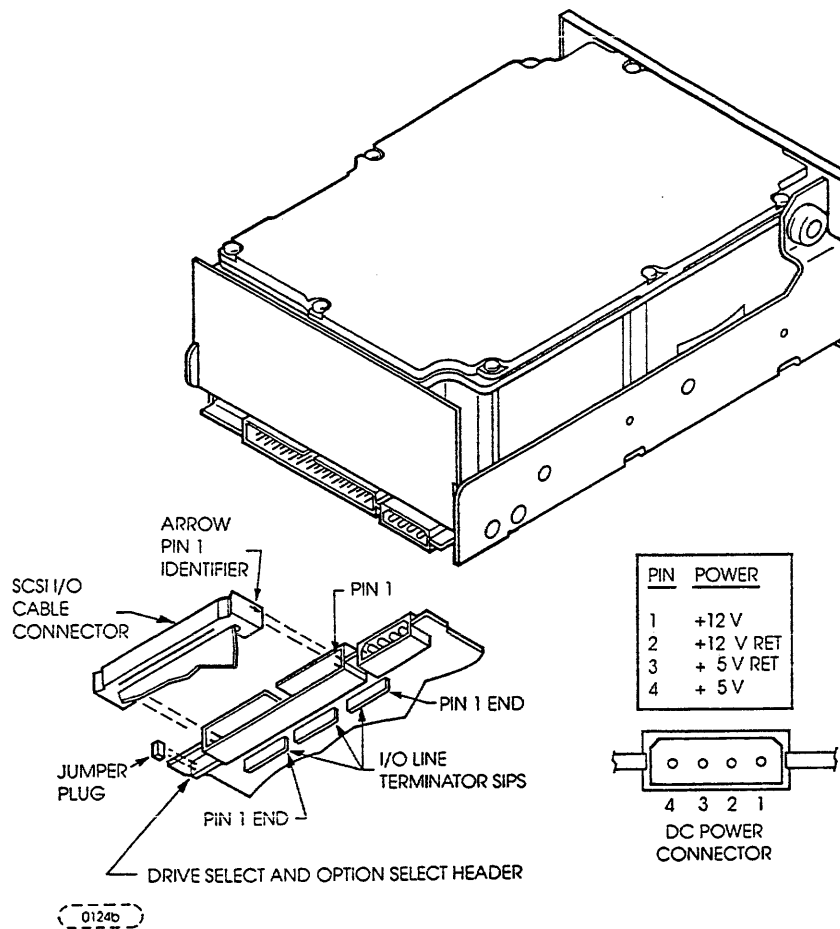


FIGURE 11.6-1. WREN PHYSICAL INTERFACE

11.7 DISC DRIVE SCSI TIMING

TABLE 11.7-1. DISC DRIVE SCSI TIMING

Description	Waveform Symbol [1]	Waveform Table [1]	Typical	Max.
Target Select Time (no Arbitration)	T00	N/A	<1 us	<250 us
Target Select Time (with Arbitration)	T01	4.5-1,2	<1 us	<250 us
Target Select to Command	T02	4.5-1	<1 us	
Target Select to MSG Out	T03	4.5-2	<1 us	
Identify MSG to Command	T04	4.5-3	<1 us	
Command to Status	T05	4.5-5	Command Dependent	
Command to Data (para. In)	T06	4.5-9	Command Dependent	
Command to Data (para. Out)	T07	4.5-10	Command Dependent	
Command to Data (Write to Data Buffer)	T08	4.5-10	<400 us	600 us
Command to Disconnect MSG	T09	4.5-6	Command Dependent	
Disconnect MSG to Bus Free	T10	4.5-6,14	<1 us	
Disconnect to Arbitration (for Reselect)	T11	4.5-6	Command Dependent	
This measures disconnected CMD overhead.				
Target win Arbitration(for Reselect)	T12	4.5-7	<5 us	
Arbitration to Reselect	T13	4.5-7	<4 us	
Reselect to Identify MSG In	T14	4.5-7	<2 us	
Reselect Identify MSG to Status	T15	4.5-8	<200 us	
Reselect Identify MSG to Data (media)	T16	4.5-11	Command Dependent	
Data to Status	T17	4.5-15	Command Dependent	
Status to Command Complete MSG	T18	4.5-5,8,15	<1 us	
Command Complete MSG to Bus Free	T19	4.5-5,8,15	<1 us	
Data to Save Data Pointer MSG	T20	4.5-14	<175 us	
Save Data Pointer MSG to Disconnect MSG	T21	4.5-14	<2 us	
Command Byte Transfer	T22	4.5-4	<0.06 us	0.1 us
Next Command Byte Access	T23	4.5-4	<0.7 us	1.0 us
<u>Asynchronous Data Transfer Characteristics:</u>				
Data In Byte Transfer (parameter)	T24	4.5-12	<0.06 us	0.1 us
Data Out Byte Transfer (parameter)	T25	4.5-13	<0.06 us	0.1 us
Next Data In Byte Access (parameter)	T26	4.5-12	<0.7 us	1.0 us

(continued)

General timing diagrams for SCSI interface operation are shown in the SCSI Interface Manual P/N 77765466, Section 4.5. The specific timing values that apply to this drive are listed in Table 11.7-1.

11.7 (continued)

TABLE 11.7-1. DISC DRIVE SCSI TIMING (continued)

Description	Waveform Symbol[1]	Waveform Table [1]	Typical	Max.
<u>Asynchronous Data Transfer Characteristics: (continued)</u>				
Next Data Out Byte Access (Parameter)	T27	4.5-13	<0.7 us	1.0 us
Data In Byte Transfer (media) [2]	T28	4.5-12	<60 ns	100 ns
Data Out Byte Transfer (media) [2]	T29	4.5-13	<60 ns	100 ns
Next Data In Byte access (media [2])	T30	4.5-12	<700 ns	1.0 us
Next Data Out Byte access (media [2])	T31	4.5-13	<700 ns	1.0 us
MSG IN Byte Transfer	T32	4.5-5,7 4.5-8,14,15	<0.06 us	0.1 us
MSG OUT Byte Transfer	T33	4.5-2	<0.06 us	0.1 us
STATUS Byte Transfer	T34	4.5-5,8 4.5-15	<0.06 us	0.1 us

Synchronous Data Transfer Characteristics:

Request Signal Transfer Period [3]	-	-	various	1020 ns
------------------------------------	---	---	---------	---------

Notes:

- [1] See SCSI Interface Manual P/N 77765466 (called Volume II), section 4.5
- [2] Maximum SCSI asynchronous interface transfer rate is given in section 5.3.
- [3] Synchronous Transfer Period is determined by negotiations between an Initiator and a Drive. The Drive is capable of setting periods as given in section 11.5. See also sections 3.1.5.2 and 3.5.3.2 of the SCSI Interface Manual (P/N 77765466) for a description of synchronous data transfer operation.

12.0 OPTIONS

All options are incorporated or packaged at the manufacturing facility.

12.1 FRONT PANEL

The normal front panel available is black plastic. Other panel colors may be special ordered. Each panel has a single rectangular LED indicator lens which, when glowing indicates the drive is selected. LED lens colors available are red, amber or green.

12.2 SINGLE UNIT SHIPPING PACK

The ST41200N/ND WREN 7 is normally shipped in bulk packaging to provide maximum protection against transit damage. Units shipped individually require additional protection as provided by the single unit shipping pack. Users planning single unit distribution should specify this option.

12.3 DRIVE TERMINATION

This option may be incorporated during manufacture at the request of the customer. For single ended interface drives, termination consists of three 220/330 ohm resistor modules (SIP's) which are installed on the Main PWA via sockets (See Figure 10.1-1).

13.0 ACCESSORIES

All accessories are designed for implementation by the customer.

13.1 FRONT PANEL KIT

Same as 12.1 but includes all mounting hardware to support field installation.

13.2 INSTALLATION MANUAL

This manual provides basic information on the care and handling of Winchester disc peripherals in general. Some information needed when installing the WREN 7 is included to assist individuals not familiar with the product. It also includes basic information to assist in obtaining service for the drive.

14.0 TECHNICAL SUPPORT SERVICES

Seagate Technology provides technical support literature and diagnostic utilities to Authorized Distributors. Please contact your dealer for technical support and installation troubleshooting. Product Technical Support is available for all Seagate products by calling the SeaFAX, SeaFONE or SeaBOARD services. These are toll calls.

SeaFAX: 408/438-2620

You can use a Touch-Tone telephone to access Seagate's automated FAX delivery system and select technical support information by return FAX. This service is available 24 hours a day, 7 days a week.

SeaFONE: 408/438-8222

The enhanced phone system provides recorded technical information on selected Seagate products while you are on hold. Technical support specialists are available to answer questions from 8:00 AM to 5:00 PM PST, Monday through Friday. Recordings are accessible 24 hours a day, 7 days a week.

SeaBOARD:

The Seagate Technical Support Bulletin Board System (BBS) is available 24 hours a day, 7 days a week. A modem is required to access this service. The communications software must be set for eight data bits, no parity and one stop bit (8N1).

With this service you can access:

- o Specifications and jumper configurations for all Seagate products.
- o Reprints of Seagate documentation.
- o A directory of information and helpful utilities that you can download to your own computer.

<u>BBS Location</u>	<u>Modem Number</u>	<u>Maximum Baud Rate</u>
United States	408-438-8771	9600
England	44-62-847-8011	9600
Germany	49-89-140-9331	2400
Singapore	65-227-2217	9600
Australia	61-2-756-2359	9600

SEAGATE PERIPHERAL FAMILY

Listed below are some of the SEAGATE Peripheral family members. For specific information on each member, refer to the appropriate documents.

<u>MODEL NAME</u>	<u>MODEL NUMBER</u>	<u>PRODUCT MANUAL</u>	<u>INTERFACE</u>	<u>UNFORMATTED CAPACITY</u>
ST1480 FAMILY	ST1400N,	77765458(I)	SCSI-2	383
	ST1401N,	77765458(I)	SCSI-2	390
	ST1480N	77765458(I)	SCSI-2	492
	ST1481N/ND	77738471(I)	SCSI-2	492*
	ST1581N/ND	77738471(I)	SCSI-2	610
	ST1480A	77738463	AT (IDE)	490
	ST1400A	77738463	AT (IDE)	381
	ST1401A	77738463	AT (IDE)	395
ST11200 FAMILY	ST11200N/ND	77738476(I)	SCSI-2	1050*
	ST1980N/ND	77738476(I)	SCSI-2	860*
WREN 7 FAMILY	ST41200N/ND	77765417	SCSI-1	1200 *
	ST41200N/ND	77765374(I)	SCSI-2	1200 *
WREN 8 FAMILY	ST41650N	77765470 (I)	SCSI-2	1650
	ST41651N/ND	77738474 (I)	FAST SCSI-2	1650*
WREN 9	ST42100N/ND	77738475 (I)	FAST SCSI-2	2200*
	ST42101N/ND	77738475 (I)	FAST/WIDE SCSI-2	2200*
SCSI Interface Manual		77765466 (II)**	SCSI-2	N/A**
SCSI Interface	ST11200N	77738479 (II)**	SCSI-2	N/A**
	ST3500N/3600N	77738479 (II)**	SCSI-2	N/A**
WREN RNR-2 FAMILY	ST4767N	77765445	SCSI-2	767 (Fast Access)
	ST4767E/769E	77765457	ESDI	767

* Product Manual covers both Single-Ended and Differential Interfaces.

** Interface Manual for several different Product Manuals (Volume II of 2 Volume set).

SEAGATE PERIPHERAL FAMILY (contd.)

<u>MODEL NAME</u>	<u>MODEL NUMBER</u>	<u>PRODUCT MANUAL</u>	<u>INTERFACE</u>	<u>UNFORMATTED CAPACITY</u>
WREN 3 FAMILY	ST4182E ST4182N	77738212 77738270	ESDI SCSI	101, 141 or 182 101, 141 or 182
WREN 3 HH FAMILY	ST2106N ST2106E	77765250 77765276	SCSI ESDI	106 (1024 Byte) 106
WREN 4 FAMILY	ST4350N ST4376N ST4376ND	77738386 77765338 77765361	SCSI SCSI SCSI	350 376 376 (Dif. I/O only)
WREN 5 FAMILY	ST4442E ST4383E ST4384E ST4702N ST4385ND/702ND ST4385N	77765300 77765300 77765300 77765336 77765366 77765378	ESDI ESDI ESDI SCSI SCSI SCSI	442 (15 Head, 1412 Cyl) 383 (13 Head, 1412 Cyl) 383 (15 Head, 1224 Cyl) 702 385, 702 (Dif. I/O) 385 (15 Head, 791 Cyl)
WREN 5 HH	ST2125N/209N	77765297	SCSI	125, 209
WREN 6 FAMILY	ST4766N/ND ST4766E	77765353 77765358	SCSI ESDI	766 (Dif. I/O)* 766, 383
WREN 6 HH FAMILY	ST2383N/502N ST2383N/502N ST2383ND/502ND ST2274A/383A ST2182E/383E	77765414 77738464 77765456 77765393 77765369	SCSI-1 SCSI-2 SCSI-2 AT (IDE) ESDI	383, 502 383, 502 383, 502 (Dif. Only) 274, 383 182, 383

* Product Manual covers both Single-Ended and Differential Interfaces.



Seagate Technology, Inc.
920 Disc Drive, Scotts Valley, California 95066-4544, USA

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